M1. (a) distance is a scalar and displacement is a vector

or

distance has magnitude only, displacement has magnitude and direction

1

(b) 37.5 km

accept any value between 37.0 and 38.0 inclusive

1

062° or N62°E

accept 62° to the right of the vertical

1

accept an angle in the range 60° −64°

accept the angle correctly measured and marked on the diagram

(c) train changes direction so velocity changes

1

acceleration is the rate of change of velocity

1

(d) number of squares below line = 17

accept any number between 16 and 18 inclusive

1

each square represents 500 m

1

distance = number of squares × value of each square correctly calculated − 8500 m

1

[8]

M2. (a) *any evidence of:* momentum = mass × velocity (words, symbols or numbers)
appropriate re-arrangement mass as 0.05kg
each gains 1 mark

but 800
gains 4 marks

4

(b) (i) *any reference to* friction with air/air resistance
gains 1 mark

but *idea that* friction with air/air resistance is high (at high speed)
gains 2 marks

2

(ii) *any evidence of:* k.e. $\propto v^2$ **or** k.e. = ½ mv^2
$\frac{\text{final k.e.}}{\text{initial k.e.}}$
either initial or final k.e. correctly calculated (i.e. 16000; 10240)
each gains 1 mark

but $(0.8)^2$
gains 3 marks

but 64%(credit 0.64)
gains 4 marks (also credit e.c.f)

4

[10]

M3. (a) (i) 3

1

(ii) 30 000 **or** 10 000 × their (a)(i) correctly calculated

1

(iii) any **two** from:

- frequency is above 20 000 (Hz)
  accept the frequency is 30 000
- frequency is above the upper limit of audible range
- upper limit of audible range equals <u>20 000</u> (Hz)
  ignore reference to lower limit
- it is ultrasound/ultrasonic

2

(b) (i) wave (partially) <u>reflected</u>

1

at crack to produce **A** and end of bolt to produce **B**
accept at both ends of the crack

1

(ii) 0.075 (m) allow **2** marks for time = 0.0000125
*allow **1** mark for time = 0.000025*
*answers 0.15 **or** 0.015 **or** 0.09 gain **2** marks*
*answers 0.18 **or** 0.03 gain **1** mark*
the unit is not required but if given must be consistent with numerical answer for the available marks

3

[9]

M4. (a) (i) same frequency / period / pitch / wavelength

ignore references to amplitude

1

(ii) differences in waveform / shape / quality

accept the diagrams are not identical

1

(b) (i) 20 000 Hz / hertz

or 20 kHz / kilohertz

*in both cases, if the **symbol** rather than the name is used, it must be correct in every detail*

1

(ii) material(s) / substance(s) (through which sound travels)

1

(iii) is absorbed

accept (some) sound (energy) is transformed / transferred <u>as</u> heat / thermal energy

1

is transmitted

accept is refracted
accept changes speed
accept changes velocity

*do **not** accept is diffracted*
*do **not** accept is diffused*
*do **not** accept is dissipated*

1

[6]